REPORT

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AND

THE COUNTRY OF TURKEY, AND

THE SOIL CONSERVATION SERVICE OF

THE UNITED STATES DEPARTMENT OF AGRICULTURE

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LAND LEVELING PROCEDURES AND GUIDELINES HANDBOOK

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GENERAL INFORMATION

This report is in compliance with the agreement PIO/T 277-426-2-80030 and is made to the United States Agency for International Development (U.S.A.I.D.)

The specific charge relative to this assignment was to provide technical advice to the GOT General Directorate of TOPRAKSU in the development of Standards and Guidelines for a Resource Conservation and Development Program.

This is a report covering the Land Leveling Procedures and Guidelines Handbook prepared by the Standards Committee of TOPRAKSU and some general observations relative to TOPRAKSU's activities in establishing and maintaining a sound and permanent irrigated agriculture. It is a supplement to the report prepared by Dolphus G. Craig and myself on Guidelines and Recommendations for a Soil and Water Conservation Program for Irrigated Lands of the Lower Büyük Menderes Project and Dry Croplands of Central Anatolia of Turkey.

It was our privilege to make field trips in the Adana, Ankara, Antalya, Izmir and Konya regions. We were well received and we are very appreciative of the many courtesies extended to us by TOPRAKSU General Directorate, members of the Standards Committee, field personnel and the people of Turkey.

LAND LEVELING PROCEDURES AND GUIDELINES

Prior to our arrival in Turkey the Standards Committee of TOPRAKSU had met and established the topics to be considered in the development of a Land Leveling Procedures and Guidelines Handbook. These topics or items are listed in brief outline form below.

I. Introduction
   1. Conditions that require land leveling, its advantages and disadvantages, definition and types of leveling.
   2. Factors that affect land leveling.
   3. Requirements for various types of land leveling according to irrigation methods.
   4. Methods of land leveling.
   5. Conditions that cause difficulties in land leveling.
   6. Standard requirements in land leveling.
   7. Methods to be used in preparation of standards.
   8. Reasons for selecting the accepted methods.

II. Surveys
   A. Collecting the data present in the office. (Topography, soils, land consolidation, time of beginning, etc.)
   B. Farm surveys.
      a. Kind of crops to be grown.
      b. Water source and discharge rate.
      c. Outlet conditions.
      d. General aspects of the land.
         1. Physical shape and legal ownership.
         2. Natural slope.
         3. Buildings and other permanent structures.
         4. Vegetative cover.

e. Desires of farmer.

f. Farm location in the regional development plan.

g. Road conditions.

h. Farm survey form.

C. Soil surveys for land leveling.

a. Depth of soil.

b. Soil texture.

c. Water table level and water quality.

d. Soil survey form.

D. Preparation of the Land for Leveling.

a. Removing grass, brush, stones, etc.

b. Smoothing the land.

c. Protection of the land.

E. Precautions necessary to protect telephone and electric cables.

F. Staking.

a. Shape of the land and location of base line according to topographic conditions.

b. Distance between stakes, their quality and dimensions.

c. Mid-point stakes.

G. Land leveling data for surveys.

a. Benchmarks.

b. Irrigation turnout and drainage outlet elevations.

c. Grid point elevations.

d. Land leveling forms.

III. Planning.

A. Preparation of maps.

a. Tables, section titles and legends.

b. Scale and direction.

c. Contours.

B. Considerations for field subdivisions.

a. Topographic conditions, slope variations.

b. Length of run.

c. Condition of irrigation and drainage channels (present and future.)

d. Land cultivation (sowing, plowing, harvest, etc.)

e. Field shape.

C. Slopes.

a. Natural slopes (lengthwise and width.)

b. Selected slopes (lengthwise and width.)

IV. Design.

A. Land leveling methods.

a. Centroid (Plan method.)

b. Profile method.

1. One direction.

2. Two directions.

c. Varied methods (plan inspection, etc.)

d. Fitting to the Contour.

e. Other methods.

B. Cut and fill calculations.

a. Summation method.

b. 4-point method.

c. Prism formula method.

d. Other calculation methods.

C. Earthwork Balance.

a. Cut and fill ratio.

b. Cut/Cut + Fill.

c. Cut and fill adjustments for irrigation channels, roads, etc.

D. Preparation of investigation summary.

E. Examination and approval of the design.

V. Operations.

A. Marking and stakes.

a. Cut stakes.

b. Fill stakes.

c. Fixing the zero notes.

B. Machine work.

a. Land observation and giving the job to the contractor.

b. Indicating bench boundaries on the land.

c. Rough land leveling (scraper, bulldozer.)

d. Fine land leveling (land plane, grader.)

e. Selecting equipment and types of machinery.

C. Checking the land leveling operation and tolerances.

D. Handing over the design file to the farmer and explanation of the work he has to do on the land.

E. Marking the leveling on the Map.

F. The task and authority of the staff.

IV. Specifications.

VII. Land leveling preliminary survey form report.

All of these items were not included in the final draft of the handbook but all of them were considered and discussed at the final formal meeting of the Standards Committee. Our active participation in this Standards Committee meeting was restricted by language difficulties. The handbook is completed and is being printed by TOPRAKSU, however English translation has not been made. A detailed review of the handbook therefore, has not been possible at this writing. When the English translation of the handbook is available a more detailed review will be made if it is desired.

Most of the land leveling in Turkey is being done with TOPRAKSU owned equipment on a project type operation. TOPRAKSU plans to divert 10 per cent of their land leveling this year to private contractors with an additional 10 per cent being diverted each subsequent year. Unfortunately, one of the prime concerns throughout the development of the handbook was the administering of contracts with private contractors.

If our understanding of what will be in the final handbook is correct the specifications for leveling are good. There are, however, some items which need to be fully understood by field personnel and properly applied.

DESIGN GRADE AND CROSS SLOPE LIMITATIONS:

Tha maximum forward constructed grade permitted in the handbook is 1.0 percent. Slopes exceeding 0.5 percent should be used only where soil depths will not permit cuts to reduce the slope. The maximum non-erosive stream on this slope is very small, field efficiencies are reduced, labor requirements are increased, and erosion hazards from natural rainfall are greatly increased. Irrigation grades generally should be as flat as possible and still provide good surface drainage.

Cross slope limitations were established according to the irrigation method to be used. Cross slope for land to be border irrigated cannot exceed 0.3 percent. When the cross slope exceeds 0.5 percent only furrow irrigation method may be used. These limitations are satisfactory to allow for soil conditions which restrict the depth of cut. It should, however, be emphasized to field personnel that little or no cross slope is highly desirable. Cross slope of 0.3 percent for borders is satisfactory when the border widths do not exceed 10 meters. If soil conditions dictate that cross slopes on fields to be furrow irrigated exceed 0.5 percent, the field should be protected from the hazard of cross slope erosion by a large border dike constructed on regular terrace spacing. There is always a tendency by field personnel to reduce the cost of leveling by using the lowest quality design permitted in the specifications. Farmers also often desire to change to different methods of irrigation as cropping systems change. Leveling should be designed to provide for the most flexibility possible. Highly productive, permanent irrigated agriculture dictates that the best quality design possible under existing soil and topographic conditions should be used.

RECOMMENDATION # 1:

In order to develope the best system possible, better use of soils information should be made by TOPRAKSU field personnel in designing projects, land leveling operations, and in providing technical assistance to individual farmers. Field personnel should be urged to develope highest quality design possible.

CONSTRUCTION TOLERANCE:

The handbook provides for a construction tolerance for rough leveling of plus or minus 4 centimeters with no reverse grades but minor undulation is acceptable. The stakes will then be removed and the field planed. A second check is made by pacing or estimating the 30 meter intervals with a tolerance

of plus or minus 3 centimeters, no reverse grades and no vicual undulations. This construction tolerance is adequate to give satisfactory quality work except on flat grades (less than 0.5 percent). But the double checking required under this procedure is not necessary to insure good quality work. It consumes technical time which could be better utilized in serving other farmers. A field which has been properly leveled with a scraper or dozer to meet the tolerance specified in the handbook does not need checking again after the stakes have been removed and the field planed with proper types of floats or land planes. Although the use of motor patrols as substitutes for planes may be expedient on an occasional job, certainly TOPRAKSU's standard procedures guide should not be patterned around improper use of equipment.

RECOMMENDATION # 2:

The handbook should be revised to require closer tolerance on constructed slopes of less than 0.5 percent and the double checking procedure eliminated.

FIELD OBSERVATIONS

In the priority established by the Standards Committee for the development of handbooks the next two books scheduled for action will be an IRRIGATION GUIDE and IRRIGATION DISTRIBUTION SYSTEM TO THE FARM. Both of these involve items which should be studied carefully before efforts are made to develope the handbooks.

To be adequate an irrigation system must have the capacity to meet the peak-use requirements of the crops to be grown, to deliver the water in the most practical way possible and deliver sufficient quantity of water for the irrigation method being used. At the present time there is a wide variation in the water requirement factor being used by TOPRAKSU field personnel. In the projects visited this factor ranged from 0.5 liters per second per hectare to 1.0 liter per second per hectare. From our experience both of these appears to be too low and would give insufficient water to the farm during periods of his peak water requirement. This factor may vary in different localities depending upon what crops are to be grown.

Since most of the irrigation in Turkey is being developed as projects involving many farmers a system of water delivery must also be developed. Through the use of planned water delivery and the proper selection of crops by the farmer to fit with this planned delivery, the one liter per second per hectare may prove to be adequate.

RECOMMENDATION # 3:

A detailed study should be made of water requirements and a water rotation plan be developed for the various irrigation projects. In order to accomplish this TOPRAKSU should assign one or more technicians this responsibility and AID should provide a long term consultant who has had experience in canal project type irrigation systems.

NEED FOR WATER MEASURING FACILITIES:

In order to obtain irrigation water management is imperative that the amount of water being delivered to the farmer be determined accurately. In some of the well and pump projects which we visited the irrigation system was designed on the basis of each well delivering 60 liters per second. These wells had not been measured for sustained production and our visual observation would indicate that the well outputs were much below this design figure. Water measuring devices are relatively inexpensive and should be considered a necessity in obtaining good water management.

RECOMMENDATION # 4:

Adequate measuring facilities should be included in all new irrigation systems being developed and added to the older systems where practical.

IRRIGATION GUIDES:

The water consumptive use rates for inclusion in the report "Guidelines and Recommendations for a Soil and Water Conservation Program for Irrigated Lands of the Lower Büyük Menderes Project and Dry Cropland of Central Anatolia of Turkey" was computed using the Blaney-Criddle formula. The figures are considerably higher than those currently in use in Turkey. Before the proposed National Irrigation Guide is developed additional study should be made on consumptive use of crops in Turkey.

RECOMMENDATION # 5:

Ring infiltrometer test should be run in sufficient quantity on the major soils being irrigated and the water holding capacity be determined. The data included in the above referred to report for water consumptive use rates should be studied further and refined if necessary. We believe a short-term consultant who has had experience in determining consumptive use rate would be very beneficial during the development of the Irrigation Guide.

WATER DELIVERY SYSTEM:

It is our strong belief that the advantages of canalettes have been over emphasized in Turkey. Canalettes are being used on well and pump irrigation systems which would have been ideal for use of buried pipelines. The use of pipeline should compare quite favorably with both canalettes and concrete ditch lining in cost of installation and in reducing water losses. It has the advantage of offering no obstruction to farming operations, no land lost to cultivation and low maintenance cost.